

European wintertime influence of Lamb Weather Types on Wind Speed, Temperature and Precipitation

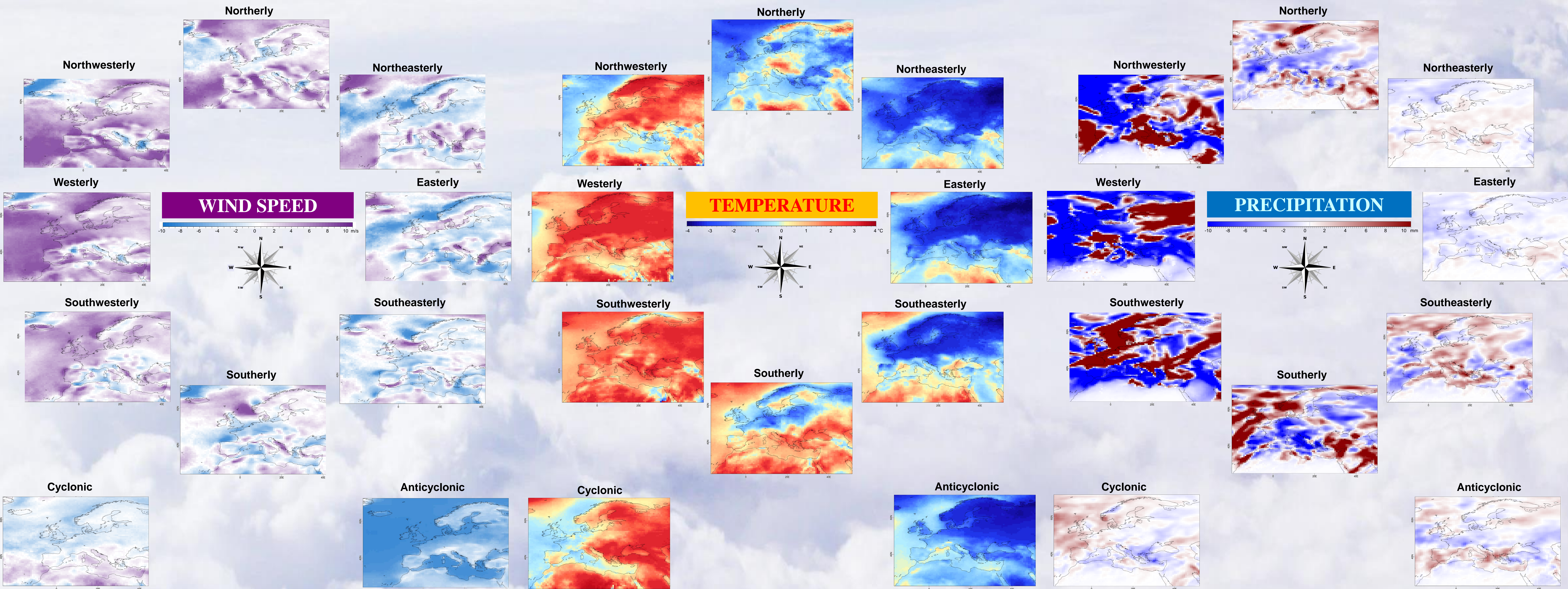
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BACKGROUND AND GOALS

- One of the main objective of synoptic climatology is the understanding of the impact of the large-scale Circulation Weather Types (WTs) in determining the local climate. Especially in the extra-tropical regions, synoptic circulation plays an important role in driving local climate. For example, it is known that Atlantic weather fronts are responsible of a high amount of winter precipitation in Europe.
- This study aims to provide for the first time a comprehensive European view of the impact of Lamb WTs on 10-m wind speed, 2-m temperature and total precipitation during winter (DJF).

DATA AND METHODOLOGY

- The weather type classification developed by Lamb (1973) to classify atmospheric circulation in 10 WTs was obtained individually at each grid point of the daily mean SLP ERA-Interim dataset (spatial resolution 0.75°) for last 30 years (1985-2014), employing a mobile 16-points regular Lamb grid to compute the geostrophical indices. Thus, each grid point was associated to a different daily WTs series. Ten WTs were obtained: 8 directional (roughly corresponding to the 8 wind directions in the wind rose), one associated to a prevailing cyclonic circulation, and one as to a prevailing anticyclonic circulation.
- Finally, the 1985-2014 average of daily anomalies of wind speed/temperature/precipitation was measured only during days belonging to a specific WT, to find the mean anomalies associated to a WT which were shown in the impact maps. Positive anomalies represent where the impact of a WT is positive for that variable (i.e: where average wind speed/temperature/precipitation is higher than its climatology for that WT). Negative anomalies show where a WT has a negative impact of the target variable. Almost all not-null anomalies were also found statistically significant with a paired t-test at 5% level.



RESULTS: WIND SPEED

- Northerly WT and the three types with a westerly component (Westerly, Southwesterly and Northwesterly) have a strong positive fingerprint on Wind Speed in winter in the most part of Europe, accordingly to the synoptic circulation in the Northern Hemisphere (strong westerly winds)
- Southerly WT and the three types with an easterly component (Easterly, Southeasterly and Northeasterly) have rarely a strong positive or negative impact, and it is usually limited to sea areas.
- Cyclonic WT has a strong positive influence only in the southern part of the Mediterranean.
- Anticyclonic WT has a strong negative impact in north-western Europe and over the Mediterranean Sea.

RESULTS: TEMPERATURE

- The three WTs with a westerly component (Westerly, Southwesterly and Northwesterly) have a strong positive impact on mean temperatures over land in winter, bringing warmer air to Europe.
- By the contrary, the three WTs with an easterly component (Easterly, Southeasterly and Northeasterly) have a strong negative impact on mean temperatures over land, bringing colder air to Europe.
- Southerly WT has a positive impact on the Mediterranean area and a negative impact in northern Europe.
- Cyclonic WT has a positive impact mainly in eastern Europe, while the Anticyclonic WT has a negative impact in the north-eastern part of Europe.

RESULTS: PRECIPITATION

- In general, the spatial patterns of the impact of the WTs on precipitation and wind speed are less homogeneous than the patterns of their impact on temperature.
- The Southerly type and the three WTs with a westerly component (Westerly, Southwesterly and Northwesterly) are very influent on precipitation on most of Europe, but they don't show any clear spatial gradient; depending on the area, their impact can be strongly positive or strongly negative.
- Northeasterly, Easterly, Cyclonic and Anticyclonic WTs have almost no impact over Europe.
- Northerly and Southeasterly types have a moderate impact over Europe.